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Finite difference approximation of electron balance problem in the stationary high-frequency induction discharges

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Abstract

© The Authors, published by EDP Sciences, 2017. The problem of finding the minimal eigenvalue corresponding to a positive eigenfunction of the nonlinear eigenvalue problem for the ordinary differential equation with coefficients depending on a spectral parameter is investigated. This problem arises in modeling the plasma of radio-frequency discharge at reduced pressures. The original differential eigenvalue problem is approximated by the finite difference method on a uniform grid. A sufficient condition for the existence of a minimal eigenvalue corresponding to a positive eigenfunction of the finite difference nonlinear eigenvalue problem is established. Error estimates for the approximate eigenvalue and the corresponding approximate positive eigenfunction are proved. Investigations of this paper generalize well known results for eigenvalue problems with linear dependence on the spectral parameter.

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References

[1] I.Sh. Abdullin, V.S. Zheltukhin, N.F. Kashapov, Radio-Frequency Plasma-Jet Processing of Materials at Reduced Pressures: Theory and Practice of Applications (Izd. Kazan. Univ., Kazan, 2000). [in Russian]
[2] A.V. Goolin, S.V. Kartyshov, Surv. Math. Ind. 3, 29-48 (1993)
[3] T. Betcke, N.J. Higham, V. Mehrmann, C. Schröder, F. Tisseur, ACM Trans. Math. Software (2013) 39, 7
[4] V.A. Kozlov, V.G. Maz'ya, J. Rossmann, Spectral Problems Associated with Corner Singularities of Solutions to Elliptic Equations (AMS, Providence, 2001)
[5] R.Z. Dautov, A.D. Lyashko, S.I. Solov'ev,. J. Numer. Anal. Math. Modelling 9, 417-427 (1994)
[6] A. Ruhe, SIAM J. Numer. Anal. 10, 674-689 (1973)
[7] V. Mehrmann, H. Voss, GAMM-Mit. 27, 1029-1051 (2004)
[8] F. Tisseur, K. Meerbergen, SIAM Rev. 43, 235-286 (2001)
[9] D. Kressner, Numer. Math. 114, 355-372 (2009)
[10] X. Huang, Z. Bai, Y. Su, J. Comput. Math. 28, 218-234 (2010)
[11] H. Schwetlick, K. Schreiber, Linear Algebra Appl. 436, 3991-4016 (2012)
[12] W.-J. Beyn, Linear Algebra Appl. 436, 3839-3863 (2012)
[13] X. Qian, L. Wang, Y. Song, J. Comput. Appl. Math. 290, 268-277 (2015)
[14] A.V. Kregzhde, Differ. Uravn. 17, 1280-1284 (1981)
[15] S.I. Solov'ev, Differ. Equations 50, 947-954 (2014)
[16] S.I. Solov'ev, Differ. Equations 51, 934-947 (2015)

[17] S.I. Solov'ev, Differ. Equations 30, 1138-1146 (1994)
[18] S.I. Solov'ev, Differ. Equations 38, 752-753 (2002)
[19] S.I. Solov'ev, Differ. Equations 46, 1030-1041 (2010)
[20] S.I. Solov'ev, Differ. Equations 47, 1188-1196 (2011)
[21] S.I. Solov'ev, Differ. Equations 48, 1028-1041 (2012)
[22] S.I. Solov'ev, Differ. Equations 49, 908-916 (2013)
[23] S.I. Solov'ev, Appl. Numer. Math. 93, 206-214 (2015)
[24] I.B. Badriev, G.Z. Garipova, M.V. Makarov, V.N. Paymushin, Res. J. Appl. Sciences 10, 428-435 (2015)
[25] I.B. Badriev, L.A. Nechaeva, PNRPU Mech. Bull. 3, 37-65 (2013)
[26] I.B. Badriev, M.V. Makarov, V.N. Paimushin, Proc. Engin. 150, 1050-1055 (2016)
[27] I.B. Badriev, G.Z. Garipova, M.V. Makarov, V.N. Paimushin, R. F. Khabibullin, Lobachevskii J. Math. 36, 474-481 (2015)
[28] I.B. Badriev, M.V. Makarov, V.N. Paimushin, Russ. Math. 59, 57-60 (2015)
[29] I.B. Badriev, M.V. Makarov, V.N. Paimushin, Proc. Engin. 150, 1056-1062 (2016)
[30] I.B. Badriev, V.V. Banderov, V.L. Gnedenkova, N.V. Kalacheva, A.I. Korablev, R.R. Tagirov, Appl. Math. Sciences 9, 5697-5705 (2015)